Pesticide Water Quality Criteria Derivation

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Outline

- Goals and guiding principles
- Project overview
- Possible outcomes
- Phase I
- Phase II status

Overall Goal

Develop a methodology for derivation of pesticide water quality criteria for the protection of aquatic life in the Sacramento and San Joaquin River basins.

Methodology Requirements

- Scientifically and technically defensible
- Work with data sets of any size
- Consider lethal and sublethal effects
- Provide a way to describe or account for uncertainty based on variability and size of the data set
- Consider differences in effects between different groups of aquatic organisms (e.g. invertebrates v. fish)

Guiding Principles

"...waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life."

(CVRWQCB 2004)

Guiding Principles

"No individual pesticide or combinations of pesticides shall be present in concentrations that adversely affect beneficial uses."

(CVRWQCB 2004)

Project Overview

- Phase I: Methodology Comparison
- Phase II: Methodology Development
- Phase III: Methodology Application
  - Chlorpyrifos, diazinon

Possible Outcomes

1. Make no change in criteria derivation methodology (i.e. continue using the USEPA 1985 guidance).
2. Adopt one of the other existing methodologies.
3. Develop an entirely new methodology.

Approach to Phase I

- Literature review
  - Criteria derivation methodologies currently in use, or proposed for use, throughout the world
  - Original studies supporting the methodologies
  - Proposed modifications of existing methodologies
  - Relevant and recent research in ecotoxicology and risk assessment.

Major Methodologies Reviewed

- USEPA 1985
- Canada 1991
- Australia/New Zealand 2000
- The Netherlands 2001
- USEPA 2003 (Great Lakes)
- European Union 2003

Approach

- What elements should be in a methodology?
- How are these elements addressed by existing methodologies?

Major Elements

- Data
- Criteria calculation

Data

- Physical-chemical data
- Ecotoxicity data
  - Acute vs. chronic
  - Hypothesis tests vs. regression analysis
  - Single-species (laboratory) vs. multispecies (laboratory/field/semi-field) data
  - Traditional vs. non-traditional endpoints
  - Multipathway exposure
  - Data estimated from interspecies relationships or QSARS

Data

- Data quality
- Data quantity—ecotoxicity

Criteria Calculation

- Assessment Factor (AF)
- Species Sensitivity Distribution (SSD)

Assumptions of Both Methods

- Random sample
- Protecting most sensitive species = protecting all species
- Surrogate species are good representatives
- Protecting species from direct adverse effects will also protect them from indirect adverse effects
- Effects that occur in laboratory tests will occur in comparable field situations

AF method

- Apply factor to lowest value
  - Range from 2-10,000+
  - Account for extrapolations:
    - Acute to chronic
    - Lab to field
    - Single- to multispecies
    - Mixtures

Evaluation of AF Method

- Easy to use
- Works with very small data sets
- Conservative; risk rarely underestimated
- Factors often arbitrary
- Full data set not utilized

SSD Method

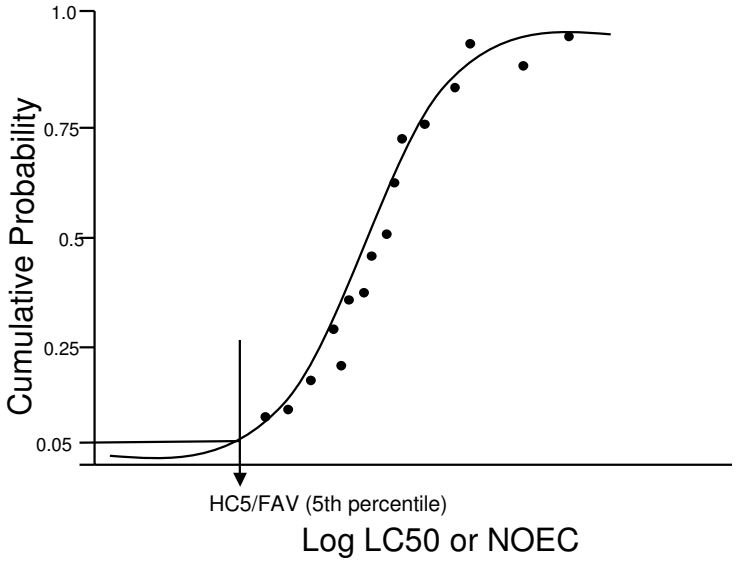

Figure 1. Generic illustration of SSD technique

SSD Method
Additional Assumption

- Extrapolation of the 5th percentile of single-species toxicity values will produce a value that is protective of the ecosystem

SSD Method Issues

- Appropriate distribution
- Number of data required
- Percentile cutoff
  - Goal is an ecosystem no effect level
- Confidence limits
- Aggregation of taxa

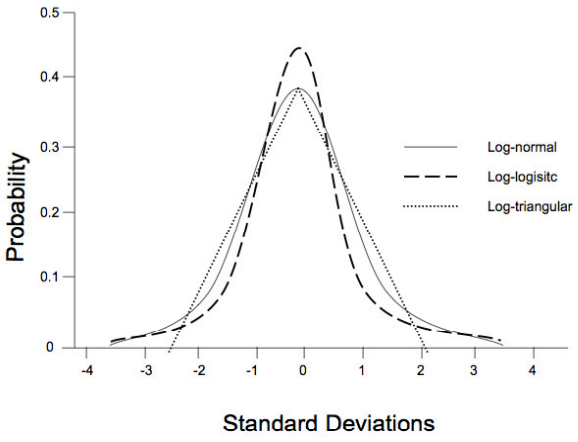

Figure 2. Comparison of log-normal, log-logistic and log-triangular distributions

Evaluation of SSD methodologies

- Distributional assumptions may not be met
- Requires minimum data set
- All data can be utilized
- Confidence levels can be determined

Best existing SSD method for addressing these: Australia/New Zealand

Other Considerations

- Exposure conditions and toxicity
  - Magnitude, duration, frequency
  - Water quality effects (pH, temperature, solids)
- Mixtures
- Bioaccumulation/secondary poisoning
- Threatened and endangered species
- Harmonization/coherence across media
- Utilization of data and data generation
- Guideline format

Conclusions and Phase II

- No existing methodology is ideal
- Components of several will be used
- New methodology will include:
  - SSD method when data are adequate
  - AF method for small data sets
- Phase II status

Method	Data used directly for derivation				SSD method[1]						AF method[2]		Criteria Considerations								
USEPA (1985)		✓		R[5]	✓			8	8				✓	✓	✓	✓	✓	✓		✓	✓
CCME (1999)		✓		S[6]							6-9	5		✓	✓						
ANZEC/ ARMCANZ (2000)		✓	✓	✓			✓	5	5	✓	1	1		✓	✓			✓		✓	✓
RIVM (2001)	✓	✓	✓			✓		4	4	✓	1	1		✓	✓			✓		✓	
USEPA (2003)		✓			✓			8	8		1	1	✓	✓	✓	✓	✓			✓	✓
ECB (2003)		✓		✓			✓	10	8	✓	1	1		✓	✓			✓			

[1] Species sensitivity distribution method
[2] Assessment factor method
[3] Survival/Growth/Reproduction
[4] Threatened and Endangered Species
[5] R = Rarely
[6] S = Secondary data only

www.waterboards.ca.gov/centralvalley/programs/tmdl/pest-basinplan-amend/index.html